Strategic Innovation Fund – Discovery Phase

DIVERSIFIED FLEXIBLE QUEUE MANAGEMENT

Lessons Learned

70103129
NOVEMBER 2023

CONFIDENTIAL

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FIRST ISSUE CONFIDENTIAL

PROJECT NO. 70103129

OUR REF. NO. 70103129

DATE: NOVEMBER 2023

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QUALITY CONTROL

Issue/revision	First issue
Remarks	First version
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Project number	70103129
Report number	70103129-R04
File reference	70103129-R04

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1 INTRODUCTION

Achieving net zero ambition relies on the integration of renewable energy sources (RES) and storage within the Great Britain power network. The RES are typically connected to distribution networks at specific locations that favour maximum generation, such as locations that are windy (for wind farms) or locations that are shade-free and southerly (for solar farm). Such requirements on locations increases the loading at specific points within the distribution network.

The connection request assessments for generation and storage traditionally consider the rated capacity of the generation units. Where capacity is not available, more capacity can be unlocked by reinforcement to the existing network infrastructure to either the distribution or transmission network (often both). With the volume of connection requests the networks are receiving and the vast majority of available capacity being allocated, there is a resultant large number of new connection applications in the queue-to-connect. The anticipated dates of connection can potentially take many years as the reinforcement works required to provide new capacity, particularly with transmission systems can take very many years and result in significant costs.

It is known that the RES are unlikely to operate at their rated capacity with the same temporal (time) signature. In an hour-by-hour operational timeframe, the actual capacity available on the network is at some times higher than the assessed planning headroom obtained through the conventional conservative network planning approach. It can also be hypothesised that greater generation capacity can be incorporated within the distribution network if the diversity of the generation resources is varied, enabling effective utilisation of the headroom available. This also has the added benefit of making more use of the installed asset base.

The Diversified Flexible Queue Management project seeks to investigate the viability of real-time network and asset data to drive network operation and adaptive management of distribution connections. It will assess the diversity of customer loads and the flexibility of their assets. It is aimed to identify actual existing and potential available capacity on the network. If this unlocks additional available capacity, then this could enable accelerated dates for the connection of RES customers.

The project is divided into three work packages (WP), and this report summarises the lessons learned.

2 LESSONS LEARNED

The Distribution Network Operators (DNO) are receiving an increasing number of connection requests for DER across their networks. While the distribution network may have capacity to connect customers, the interaction between the transmission and distribution networks (at grid supply points (GSPs)) and network capacity constraints on the transmission networks are resulting in a range of export limitations at the GSP imposed by the transmission system operator. This limitation affects the whole of the part of the distribution network who's network architecture is sited below this GSP.

The conventional approach to evaluating the available headroom at the GSP interface is based on a minimum approach that prioritise health and safety of the operation of the grid. And experience/observations from historical data have suggested the same. The traditional approach of headroom evaluation significantly limits or delays the new connections at the GSP as the transmission system awaits the completion of its reinforcement work to realise greater capacity, and therefore greater capacity headroom.

Key technical findings of the discovery phase investigation into this problem are summarised below.

- In WP1 [1], the report analyses the headroom available at various GSPs within the distribution network of Northern Powergrid (NPg). The analysis utilises publicly available GSP operational metering time series data available through NPg website. The maximum expected worst-case power flow (conservative approach to identify headroom) is determined with respect to current connected generation and the contracted but not yet connected generation.
- A methodology to ascertain the maximum generation capacity utilising the dynamic headroom at the GSPs is proposed. The methodology relies upon the actual power flow at the GSP rather than on the worst-case expected power flow to determine the limit of penetration of new generation capacity. Furthermore, the methodology evaluates the impact of the composition of the generation technology on the limit of generation capacity at the GSP.
- In WP3 [1], the project further explored optimisation opportunities to determine the ideal mix of generation for maximising the utilisation of headroom at GSPs. The outcomes support the feasibility of employing optimisation algorithms to enhance capacity, which will be further explored in the Alpha phase. Additionally, the potential to unlock hosting capacity using storage or flexible demand is analysed, offering a glimpse of how these technologies could optimise GSP operation by considering energy diversity and cost factors.
- It should be mentioned that the analysis presented is preliminary and specific to the GSP under consideration. However, the analysis presented serves as a proof-of-concept that will be taken forward for evaluation in the next phase of the project. Furthermore, the methodology is generic and can be applied to any GSP within the Great Britain power network.

In the meantime, the project has also been looking at the commercial and policy aspects of the problem.

- According to the WP2 [2], in general, the existing process of queue management does not preclude the adoption of DFQM. Furthermore, the systems that exist currently allow for the modification of the existing regulations via processes like CMPs. However, there are still threats inherent in making this change to the system.

- Saturation of network requirements: It is variously mentioned that the current volume of applications in the queue may exceed actual network requirements, i.e. there may be a large number of projects in the queue that, due to saturation, will not ultimately be connected. Thus, there is a potential risk that moving projects forward in the queue via DFQM will lead to other applicants feeling that they are effectively having their projects cancelled. This could lead to pushback and potential challenges.

- Reaction of non-flexible applicants: In the context of preferential treatment or connection offers for those applicants that agree to provide flexibility services and are suitable for DFQM, there will inevitably be applicants who feel that they are being side-lined. This could result in reduced engagement from these parties, potentially included missed milestones or slowed progress, and could even lead to legal challenges. This could be best mitigated by clarity of communication and engagement with these parties, particularly around the benefits offered by DFQM in freeing up additional network capacity.

- Potential centralisation of the national connections queue: While this is not presented as an option by the ESO's consultation on connections reform, the far-reaching scope of this kind of measure could significantly interfere with the DNOs' operation of DFQM. However, any re-organisation on this scale would be preceded by lengthy reviews and consultation processes, and so engagement from the DNOs could reduce the likelihood of this risk occurring.

- These threats however can be managed during the development of the DFQM process, and do not invalidate the potential benefits to the networks and consumers.

In the Alpha phase of our initiative, our high-level strategy is grounded in a holistic approach that converges technical excellence, commercial viability, and robust policy adherence. On the technical front, we will be integrating invaluable insights garnered from the Discovery Phase, fostering an iterative and data-driven approach to develop a comprehensive and adaptable framework. It will incorporate the diverse and flexible nature of renewable energy sources into connections queue management.

Commercially, our high-level strategy incorporates thorough Cost-Benefit Analysis (CBA) as a pivotal component of our commercial approach. In the policy realm, our commitment to compliance with regulations and process considerations remains unwavering. We will be addressing any identified policy challenges from the Discovery Phase to ensure the seamless integration of our initiative within legal frameworks and the conversion into business as usual (BAU). This comprehensive strategy aims to not only navigate the complexities of the project idea effectively but also lay a robust foundation for subsequent stages of development and deployment.

3 DISSEMINATION

Dissemination of insights and progress is a critical aspect of our strategy during the Discovery Phase. We recognise that effective communication is paramount to building awareness, garnering support, and facilitating collaboration. Our approach to dissemination involves transparently sharing key findings, technical advancements, and commercial developments with relevant stakeholders. This includes internal teams, external stakeholders, regulatory bodies, and end-users.

3.1 INTERNAL TEAM MEETINGS

Internally, weekly updates and collaborative workshops are established to ensure that all team members are aligned with the project's trajectory. All partners are engaged through targeted communications, providing them with a comprehensive understanding of our progress and addressing any collaborative opportunities or concerns.

3.2 STAKEHOLDER ENGAGEMENT

Stakeholder engagement is integral to our strategy during the Discovery Phase, as it plays a pivotal role in shaping the trajectory and success of our initiative. We adopt a proactive and inclusive approach to identify, understand, and involve key stakeholders at various levels of the project. They were engaged through user feedback sessions, surveys, and informative materials. A stakeholder engagement summary presentation and report were concluded.

3.3 REGULATORY BODIES MEETINGS

Regulatory bodies are kept informed to ensure ongoing compliance, including kick-off meetings, mid-point review meeting and end point meetings. A show & tell workshop was also held and the key findings of this project was disseminated through the event to the wider community.

3.4 CONFERENCE PAPER

A paper [3] was developed at the Discovery Phase and will be published at the IET Renewable Power Generation and Future Power Systems Conference to be held on 15th and 16th November 2023 in Glasgow. Publishing a conference paper is a commendable step in the dissemination of knowledge and findings from your initiative. This not only contributes to the academic community but also serves as a powerful tool for stakeholder engagement and visibility. The conference paper provides a structured platform to communicate the technical intricacies, methodologies, and outcomes of the Discovery phase.

3.5 WIDER DISSEMINATION

We leverage diverse channels for dissemination, including reports, presentations, online platforms, and interactive sessions. This multifaceted approach ensures that information reaches stakeholders in accessible and engaging formats, fostering a shared understanding of our goals and progress. By prioritising effective dissemination, we aim to build a supportive network around our initiative, leveraging collective insights to drive success as we transition from the Discovery phase to subsequent stages.

4 REFERENCES

[1] WSP, “Diversified Flexible Queue Management Discovery Phase - Quantifying and Analysing Network Congestion and Queue Management Report,” 2023. [Online]. Available: https://smarter.energynetworks.org/projects/npg_sif_002/.

[2] WSP, “Diversified Flexible Queue Management Discovery Phase - Review of existing network congestion and queue management arrangements,” 2023. [Online]. Available: https://smarter.energynetworks.org/projects/npg_sif_002/.

[3] M. Syed, N. Shams, J. Li, L. Brown and A. Emhemed, “Diversified Flexible Queue Management: Analysis of Great Britain Distribution Network Hosting Capacity with Diversification of Generation and Demand,” in *Renewable Power Generation and Future Power Systems Conference 2023*, Glasgow, 2023.

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